

HF100H SERVICE MANUAL

This manual is established for repair•adjustment of the MinXray model HF100H portable x-ray unit. Copy and transfer without notice is prohibited.

Section	Contents	Page
1.0	Introduction	1
2.0	Device history	2
3.0	Specifications	3
4.0	Operating procedures	5
5.0	Pre-adjustment	7
6.0	Re-adjustment of kV	11
7.0	Re-adjustment of Pre-heat time and mA	13
8.0	Re-adjustment of exposure time	16
9.0	Sample of output waveform	17
10.0	Trouble shooting Guide	18
11.0	Wiring diagram	22
12.0	Schematic Diagram	23
13.0	HF100H Parts List	27
14.0	Collimax Collimator operator's installer's manual	28
15.0-1	Pre-adjustment with HF Tester	40
15.0-2	Pre-adjustment without HF Tester	41

1.0 Introduction

This service manual is for the MinXray model HF100H x-ray unit.

If you have any questions or need further assistance, please contact us. We are available Monday - Friday, 8:30 - 17:00 Central Time.

Service Department
MinXray, Inc.
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Northbrook, Illinois 60062-1822
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Tel: 1-847-564-0323
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Internet: www.minxray.com



Always connect the power cord to a grounded AC mains electrical outlet.



High voltage is present in some internal components.



X-radiation is emitted during some calibration tests described within this manual. Observe radiation safety precautions when conducting these tests.

CARELESS OR IMPROPER USE OF X-RAY EQUIPMENT CAN BE EXTREMELY HAZARDOUS. It is imperative that this equipment be operated and serviced only by trained personnel familiar with the safety precautions required to prevent excessive exposure to primary and secondary radiation, the dangers of exposure to x-radiation, and the proper use of the equipment and instrumentation discussed in this manual. All personnel authorized to operate or service this equipment should be fully acquainted with the established maximum permissible doses, safety recommendations and procedures for working with high voltage components, and testing and calibration instrumentation.

Although this x-ray unit incorporates protective design features for limiting both the direct (primary) x-ray beam and the secondary radiation produced by this beam, design factors alone cannot prevent human carelessness, negligence, or lack of knowledge. This apparatus is sold with the understanding that the user assumes sole responsibility for radiation and electrical safety, and that MinXray, Inc., its agent and representatives, do not accept any responsibility for:

1. Injury or danger to patient or other personnel from x-ray exposure or electrical shock.
2. Overexposure due to poor operating techniques or procedures.
3. Equipment not properly serviced, installed, or maintained in accordance with operation and service manuals.
4. Equipment which has been modified or tampered with in any way.

2.0 DEVICE HISTORY

Item No.	Contents	Start S/No.
1	Pre- production	19716
2	Solder Lead on the insert	21192
3	Making 8 screws lock tighter for out case	21545
4	Fixing the nut of PCB M9110 by bond (KE42)	23232
5	Using PCB M3107-B	23232
6	Adding the label	23232
	Dangerous Voltage & Ionizing Radiation	
7	Adding the fixing metal for insert	23539
8	Adding the fixing metal for collimator	23539
9	Changed the insert for balance collimator (D-180HS-G)	25150

NOTE : The parts list is used from MinXray HF100H (S/No. 25150)

3.0 SPECIFICATIONS

POWER : Range ----- 100 ~ 130VAC, 200 ~ 260VAC
Minimum voltage with no load ----- 100VAC, 200VAC
Maximum voltage with no load ----- 140VAC, 280VAC
Frequency ----- 50/60Hz
Electricity consumption -----

	Minimum	Maximum
110V	16A(40kV)	30A(100kV)
220V	8A(40kV)	15A(100kV)

Maximum voltage consumption ----- 3.5kVA $\pm 10\%$



NOTE : This unit would be severely damaged if it is used with incorrect line voltage. Check the rating label on the HF100H for the correct input voltage for each unit.

OUTPUT : Inverter : 120kHz high frequency inverter system with neutral ground circuit, 2kW • 60kHz inverter.
tube potential feedback system
tolerance $\pm 10\%$

Filament circuit : 0.5 Watt • 45kHz inverter
tube current feedback system
tolerance $\pm 10\%$
pre-heat time : approximately 2sec.

WARM UP TIME : Approximately 10 seconds after each exposure and after the initial Power-on.

X-RAY OUTPUT : Maximum tube voltage : 100kV $\pm 10\%$
Minimum tube voltage : 40kV $\pm 10\%$
kV switch : 2kV steps
Tube current : 20mA constant $\pm 10\%$
Timer range : 0.08 – 4.00 sec. 0.01 sec. steps
Tolerance $\pm 10\%$

X-RAY TUBE : TOSHIBA D-124S
focal spot size : 1.2mm $\times$ 1.2mm
target material : tungsten
angle : 16 °
anode heat storage capacity : 14kJ (20.0kHU)

COLLIMATOR : Collimax model D-180HS-G
Continuously adjustable light beam type with central ray indicator, and cassette size/distance indicator to aid in correct positioning.

On time : 30 sec.
Bulb : Philips No.6550 15V150W
Blub life : longer than 50 hours
Illuminance : over 160 lux at 1 m SID
Contrast ratio : over 3:1 at 1 m SID

NOTE: Please refer to Collimator Operator's and installer's manual (Page 20)

FILTRATION :	inherent filtration	2.2mm Al
	collimator filtration	1.2mm Al
	total filtration	3.4mm Al

WEIGHT : 20kgs

SIZE : 29 cm (W) × 23.8 cm (H) × 45.5 cm (L)

POWER CORD : 3.6 m

EXPOSURE SWITCH : two stage, 3.0 m

4.0 OPERATING PROCEDURES

CONNECTION : After confirming POWER CORD and EXPOSURE SWITCH are intact, securely connect them to main body of x-ray unit.
(If connector has lock, confirm it is locked.)
Confirm POWER SWITCH is OFF and connect POWER CORD to wall outlet or wall socket of proper mains.
(When you use an extension cord, 3.5kW should be obtained.)

POWER ON : Set POWER SWITCH on control panel to ON. Each indicator will illuminate. When the unit is warming up (WARM UP indicator is lit), exposures can not be taken. After approx. 10 sec., WARM UP indicator will go off. The unit is now ready to use.



DO NOT SWITCH ON AND OFF QUICKLY IN A SHORT TIME. WHEN TURNING ON AGAIN AFTER TURNING OFF, WAIT FOR AT LEAST 1 MINUTE. OTHERWISE, THE HIGH FREQUENCY INVERTER CANNOT WORK PROPERLY.

kV SETTING : Set kV in the range of 40kV to 100kV.

TIMER SETTING : Set timer in the range of 0.08 sec. to 4.00 sec. depending on subject, distance and screen/film combination. Time increments are 0.01 sec. per step.

SOURCE-IMAGE DISTANCE:

Use the tape measure on the side of the HF100H to confirm that the x-ray unit is positioned at the correct source-image distance (SID) for the view being taken.

ADJUSTMENT OF RADIATION FIELD :

Pressing the collimator switch will illuminate the field for approx. 30sec. Adjust light field to position of radiograph by two knobs for adjustment of opening.
During this time, use the adjustment knobs to size the radiograph as you need.

RADIOGRAPHY :

Make sure that WARM UP indicator is OFF before pressing the exposure switch.



**WARM UP INDICATOR TURNS OFF 10 SEC. AFTER POWER ON.
WARM UP INDICATOR TURNS OFF 10 SEC. AFTER EACH EXPOSURE.
IF WARM UP INDICATOR IS ON, X-RAY EXPOSURE IS IMPOSSIBLE.**

Make sure all WARNING LAMPS are off.
After all safety checks, press only first stage of EXPOSURE SWITCH. STANDBY indicator goes off after 1 sec. Then, unit is ready for exposure. Press and hold the second stage of EXPOSURE SWITCH. X-RAY indicator illuminates, the buzzer sounds, and x-ray is generated for the time set. The EXPOSURE SWITCH is a DEADMAN style. If the button is released, exposure is stopped. So, press and hold the button until exposure is complete.

WARM UP indicator will light after exposure.



NOTE : The first stage of EXPOSURE SWITCH is pre-heat of filament.
DON'T KEEP ONLY THE FIRST STAGE OF EXPOSURE SWITCH "ON" LONGER THAN 30 SEC.

POWER OFF : When the POWER SWITCH is pressed, all indicators on the control panel are off.

WARNING LAMP : HF100H has 2 kinds of warning lamps. If either of them is lit, x-ray cannot be generated. Each detail is as follows.

WARNING LAMP	DETAILS	COUNTERMEASURE
WARM UP	The internal circuit is warming up.	Wait until light goes off.
ERROR	Unit malfunction.	Stop procedure and follow steps below.

※ If ERROR indicator is lit even when EXPOSURE SWITCH BUTTON is released, it means an unusual situation has occurred. Turn off POWER SWITCH, wait 3 minutes, then start procedures over again.

※ This unit generates x-ray by an inverter. Therefore, it requires warm up time to be stable after power on and each exposure. When WARM UP indicator is off, warm up is finished.

5.0 Pre-adjustment (Refer to page 40, page 41)

※ Each PC Board delivered from the factory has already been adjusted.

1. 24VDC power supply adjustment (SVB24SA)

Check output (DCV) at Red (+) and Black (−) wires. Adjust VR on the SVB24SA to be $C24V \pm 0.3V$.

2. M3108A adjustment (Refer to page 8)

kV adjustment : kV is decreased by turning clockwise.

1. This adjustment requires the special test equipment (HF Tester).
2. Check the DC voltage between the kV (+) and GND on the test equipment (HF Tester).
3. Set the kV selector to 100kV and turn VR1 so that the DC Voltage is 5.0V.
4. Check the voltage at each kV setting.
5. Finally check the kV by using an external kV tester such as the VICTOREEN NERO. The reading will indicate a little lower than the actual output because of the tester dynamics for high frequency x-ray production, so don't adjust over 99kV indicated by testing device.

mA adjustment : mA is decreased by turning clockwise.

1. This adjustment requires the special test equipment (HF Tester).
2. Check the DC voltage between the mA (+) and GND on the test equipment (HF Tester)..
3. Confirm the mA indicator to be 20mA and turn VR5 so that the DC Voltage is 2.0V.

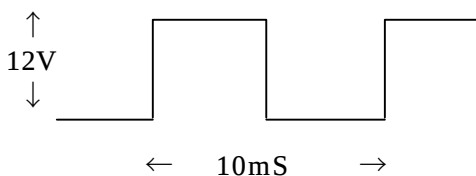
Exposure time adjustment : Exposure time is decreased by turning clockwise.

Time base is 100Hz (10msec.). When jumper of JP2 is pulled out, X-RAY LED is lit without relating to timer. Measure voltage between TIME test point and GND test point by Oscilloscope, and adjust by VR6.



IMPORTANT : Disconnect the connector JP2 on M3108A PCB before removing the jumper of X-RAY. Otherwise, Inverter PC Board will work and X-RAY will be generated unrelated to timer setting and X-RAY unit might be damaged.

※ Pull in and pull out connectors only with MAIN POWER OFF.



※TIME BASE WAVEFORM

NOTE : Please contact MinXray, Inc. (Service Department) if you need information of the special test equipment (HF Tester).

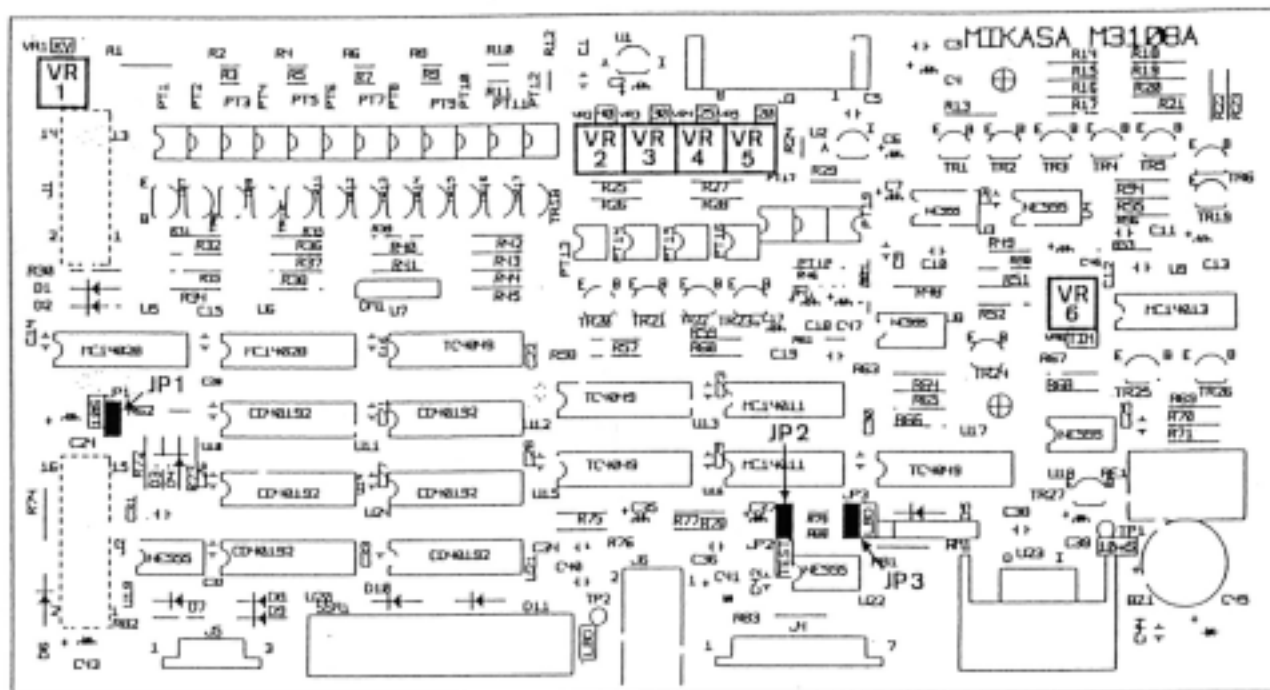
REFERENCE : There are three jumpers on M3108A (10SEC ,TEST and LBD)

10SEC : When jumper is put in, WARM UP time is 1 sec. DO NOT USE. When jumper is pulled out, it is 10 sec.
This jumper is for adjustment at the factory before shipment.
So, please don't use the device with jumper.



TEST : **※NEVER PULL OUT THIS SHORT PIN. X-RAY WILL BE GENERATED PERMANENTLY AND DANGEROUSLY.**

LBD: Not used



3. M9111 PC Board adjustment (refer to page 9)

It can adjust the following:

- ※Over Voltage Protection circuit (VR1)
- ※Over Current Protection circuit (VR2)
- ※DC voltage adjust circuit (VR3)

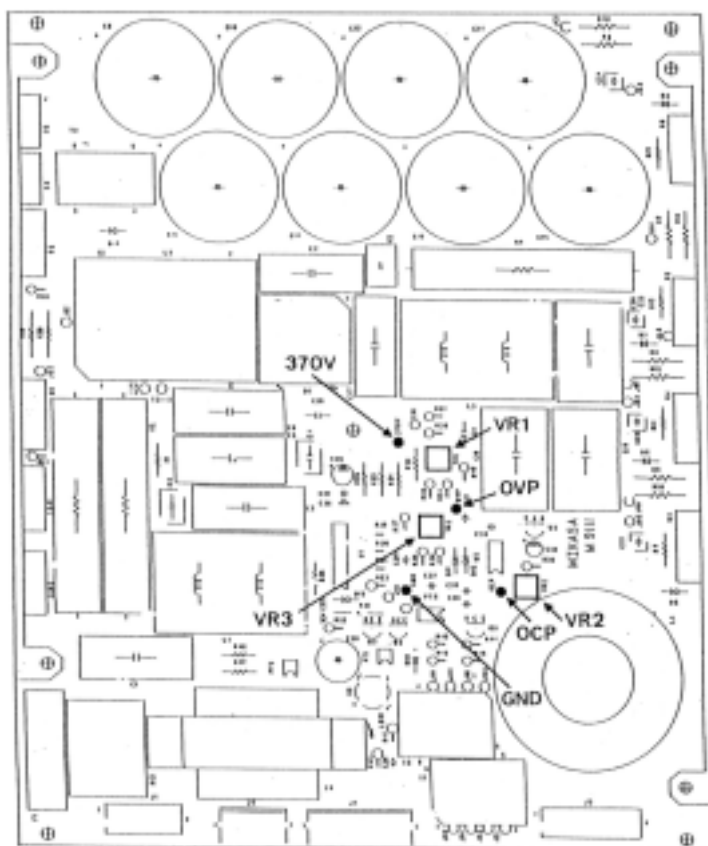
Calibrated DC voltmeter is necessary.

4. M9112 PC Board adjustment (refer to page 10)

It can adjust the following:

- ※Frequency of Inverter PC Board (VR1)
- ※Pre-heat time for Low mode (VR3)
- ※kV (VR4)
- ※mA (VR5)

M9111 PC Board adjustment



**This adjustment has to be done after connecting all connectors completely.
Actual x-ray exposure is not necessary.**

※Each PC Board delivered from the factory has been already adjusted.

1. Adjustment of VR3 (DC370V)

Adjust voltage between 370 (+) and GND (–) to be 368.5 – 372V by turning VR3.

Voltage is increased by turning clockwise.

2. Adjustment of VR2 (Over Current Protection circuit)

Adjust voltage between OCP(+) and GND (–) to be 1.09 – 1.11V by turning VR2.

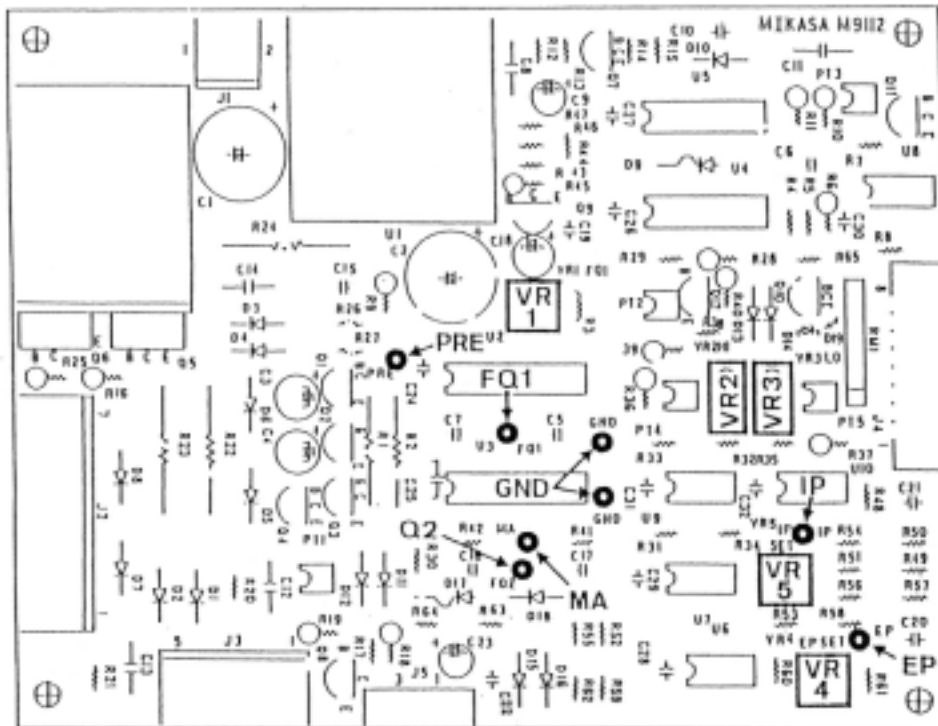
Voltage is increased by turning clockwise.

3. Adjustment of VR1 (Over Voltage Protection circuit)

Adjust voltage between OVP (+) and GND (–) to be 2.4 – 2.45V by turning VR1.

Voltage is decreased by turning clockwise.

M9112 PC Board adjustment



This adjustment has to be done after connecting all connectors completely. Actual x-ray exposure is not necessary.

※Each PC Board delivered from the factory has been already adjusted.

1. Adjustment of FQ1

Adjust frequency between FQ1 (+) and GND (–) to be 120kHz by turning VR1.

Frequency is increased by turning clockwise.

2. Confirmation of FQ2

Confirm if frequency between FQ2 (+) and GND (–) is 90kHz $\pm 5\%$. It cannot be adjusted.

3. Adjustment of Pre-heat voltage at 20mA.

Adjust voltage between PRE (+) and GND (–) to be 0.43V by turning VR3.

Voltage is increased by turning clockwise.

4. Set VR4 (EP SET) to the center position.

5. Set VR5 (IP SET) to the center position.

6.0 Re-adjustment of kV



This adjustment has to be done after connecting all connectors completely. Actual exposure is necessary.

NOTE : This adjustment requires that an exposure be made. Please observe all radiation related safety precautions.

※This adjustment should be done whenever Insert Box or Inverter PC Board (M9101B PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112 PC Board. (refer page 9)

Setting of oscilloscope : CH1 ; 1V/div, CH2 ; 0.5V/div, 10msec/div

Setting of x-ray device : 0.1 sec., 70kV

Place of adjustment : VR4 on M9112 PC Board (EP SET)

Method of adjustment : Measure x-ray tube voltage by oscilloscope and adjust average of peak values of EP waveform to be 3.4V by VR4.
After the adjustment is finished, set of device to be 100kV and adjust again so that average of peak values of EP waveform to be 4.9V.

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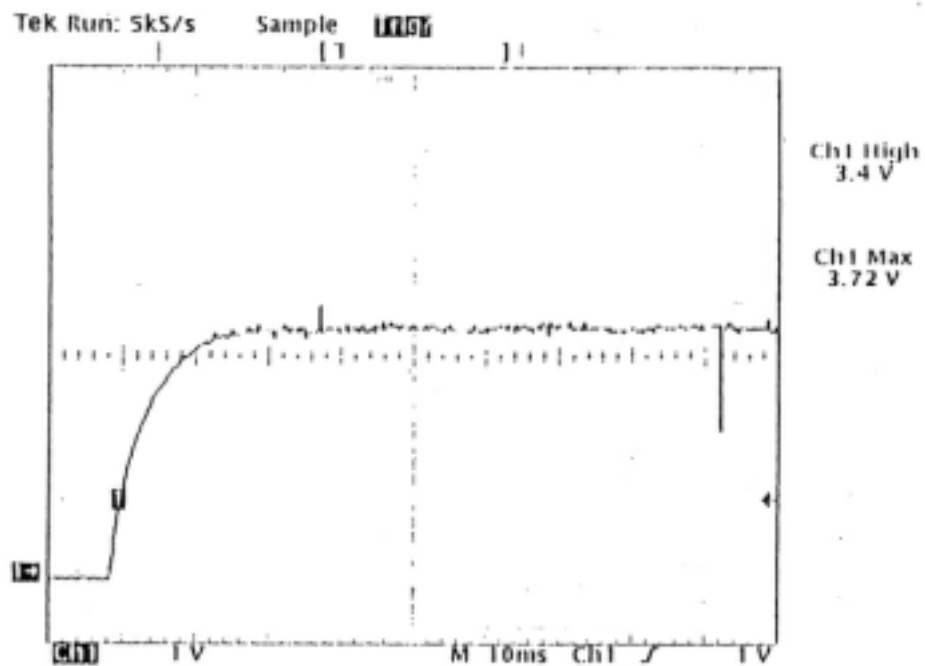


When x-ray tube voltage is measured by non invasive direct x-ray measuring equipment such as NERO, approx. 3kV of deviation is included. Therefore, adjust kV to be 97.5 ~ 99kV at 100kV station.

5 – 1. Adjustment of 70kV by VR4

Adjust the ch1 (Ep) by VR4 to be $3.4\text{V} \pm 0.5\text{V}$.

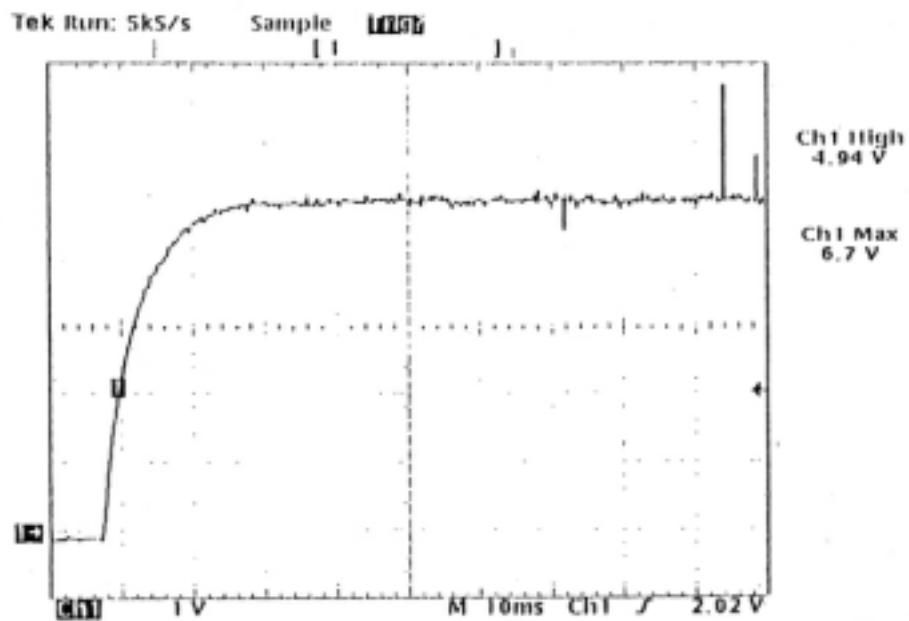
kV is increased by turning clockwise.



5 – 2. Adjustment of 100kV by VR4

Adjust the ch1 (Ep) by VR4 to be $4.9\text{V} \pm 0.5\text{V}$.

kV is increased by turning clockwise.



7. 0 Re-adjustment of Pre-heat and mA



This adjustment has to be done after connecting all connectors completely.
Actual exposure is necessary.

NOTE : This adjustment requires that an exposure be made. Please observe all radiation related safety precautions.

*This adjustment should be done whenever Insert Box or Inverter PC Board (M9112 PCB) is replaced.

Oscilloscope (with storage mode) : Connect CH1 probe to EP, CH2 probe to IP, and GND to GND terminal on M9112 PC Board. (refer page 9)

Setting of oscilloscope : CH1 ; 1V/div, CH2 ; 1V/div, 10msec/div

Setting of x-ray device : 0.1 sec., 80kV

Place of adjustment : VR3 (Pre-heat voltage) • VR5(mA)

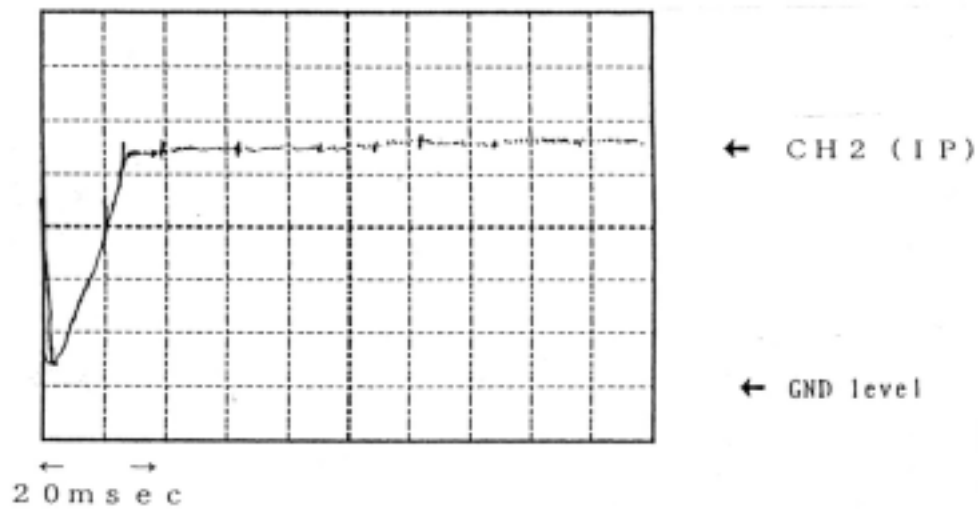
VR3 : adjustment of Pre-heat time at 25~20mA.
(Pre-heat time is shorten by turning clockwise.)

VR5 : set 20mA and adjust to be 19mA

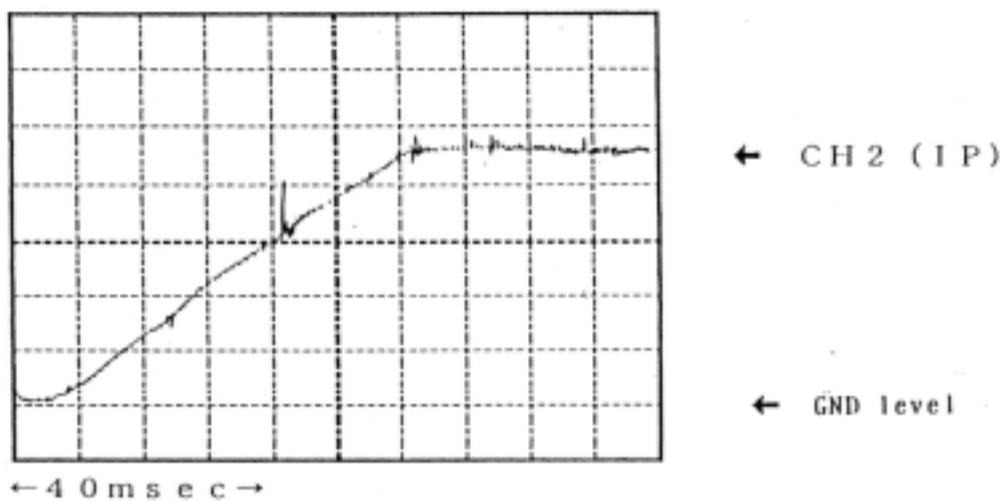
※Pre-heat time should be adjusted to be 30msec.±10msec.

6-1. Adjustment of Pre-heat time

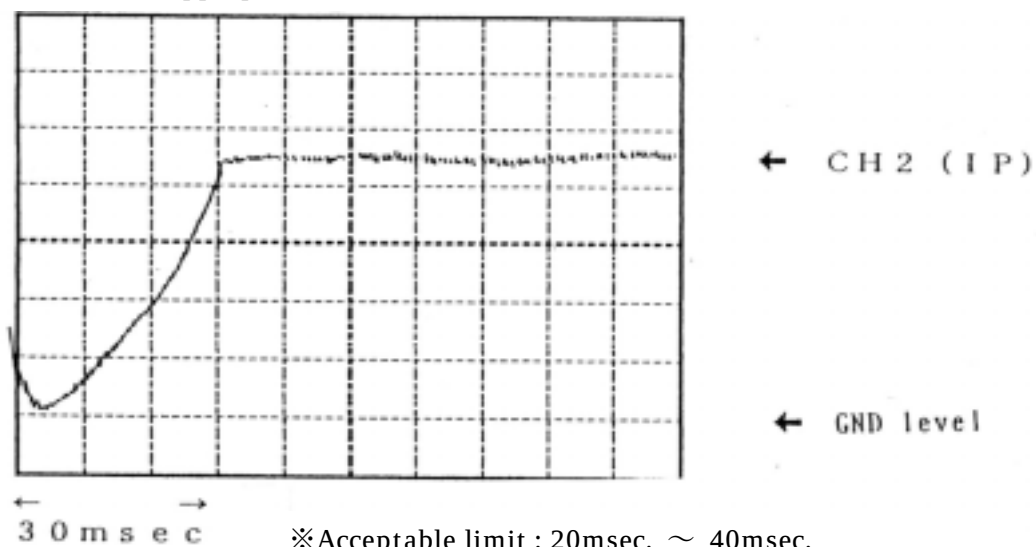
1. Pre-heat time is short. Make Pre-heat time longer by turning VR3 counterclockwise.



2. Pre-heat time is long. Make Pre-heat time shorter by turning VR3 clockwise.



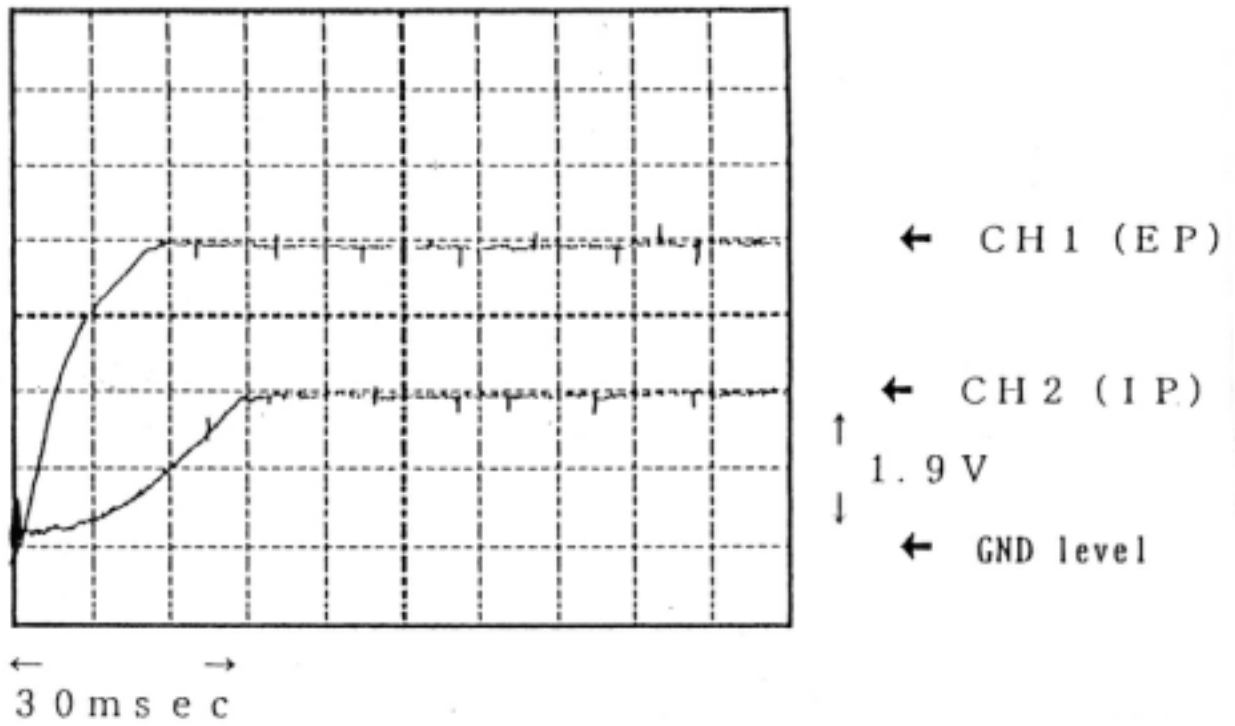
3. Pre-heat time is appropriate.



※Acceptable limit : 20msec. ~ 40msec.

6-2-1. Adjustment of mA by VR5

※Adjust average of peak values of IP waveform to be 1.9V by VR5.



8.0 Readjustment of exposure time



This adjustment has to be done after connecting all connectors completely.
Actual exposure is necessary.

NOTE: This adjustment requires that an exposure be made. Please observe all radiation related safety precautions.

Check the exposure time by using an external exposure time meter such as the VICTOREEN NERO.

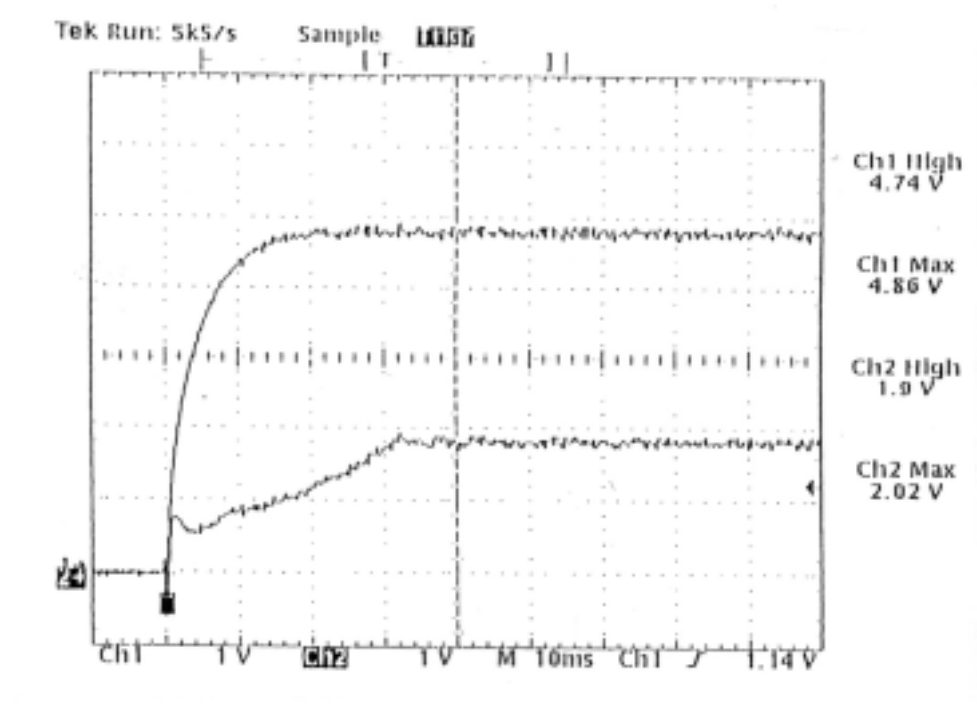
X-ray unit setting: 82kV • 0.5sec

Adjustment: Exposure time is decreased by turning clockwise. (VR6 on the M3108A PC board)

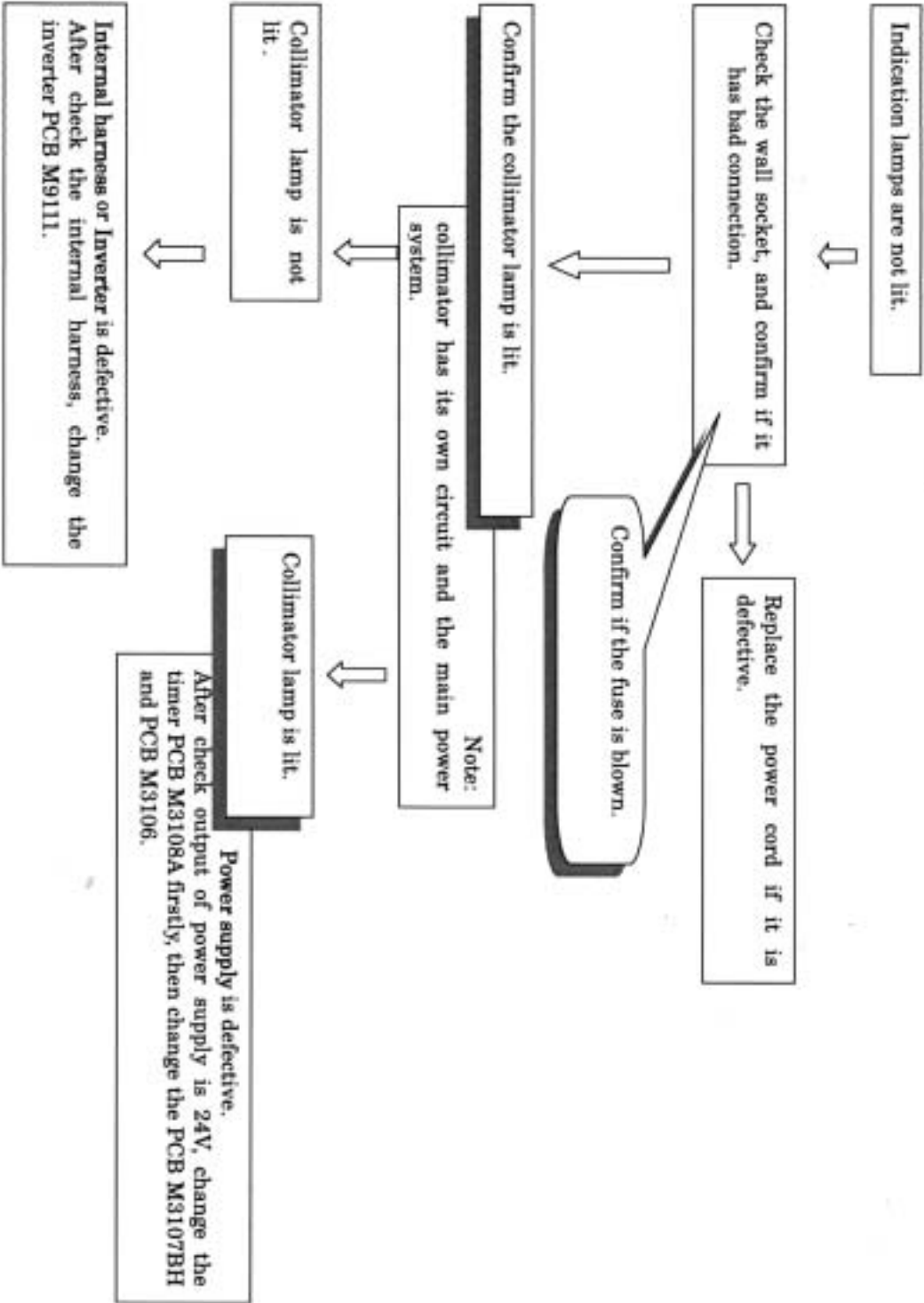
9.0 Sample of output waveform

Normal waveform

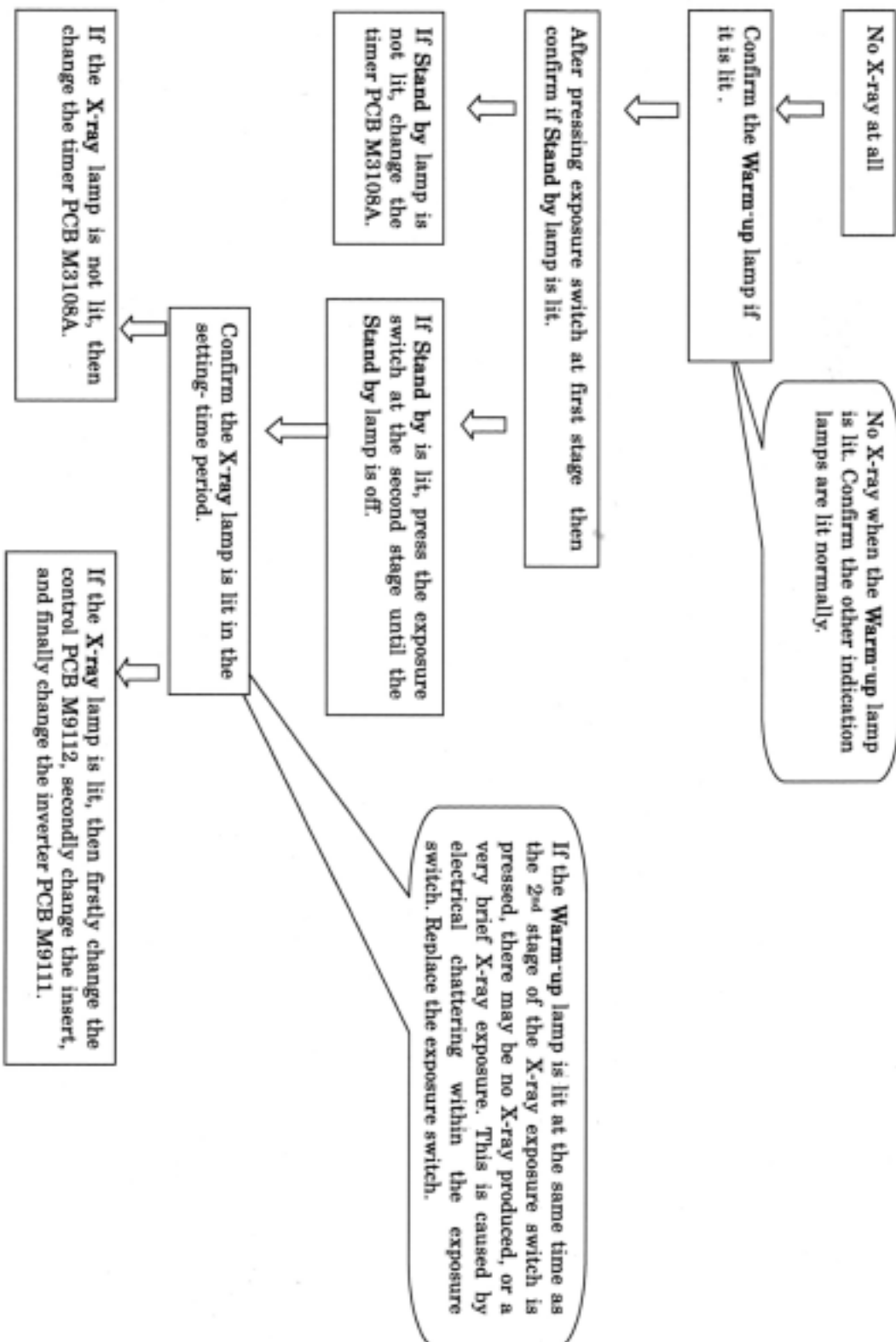
100kV · 20mA



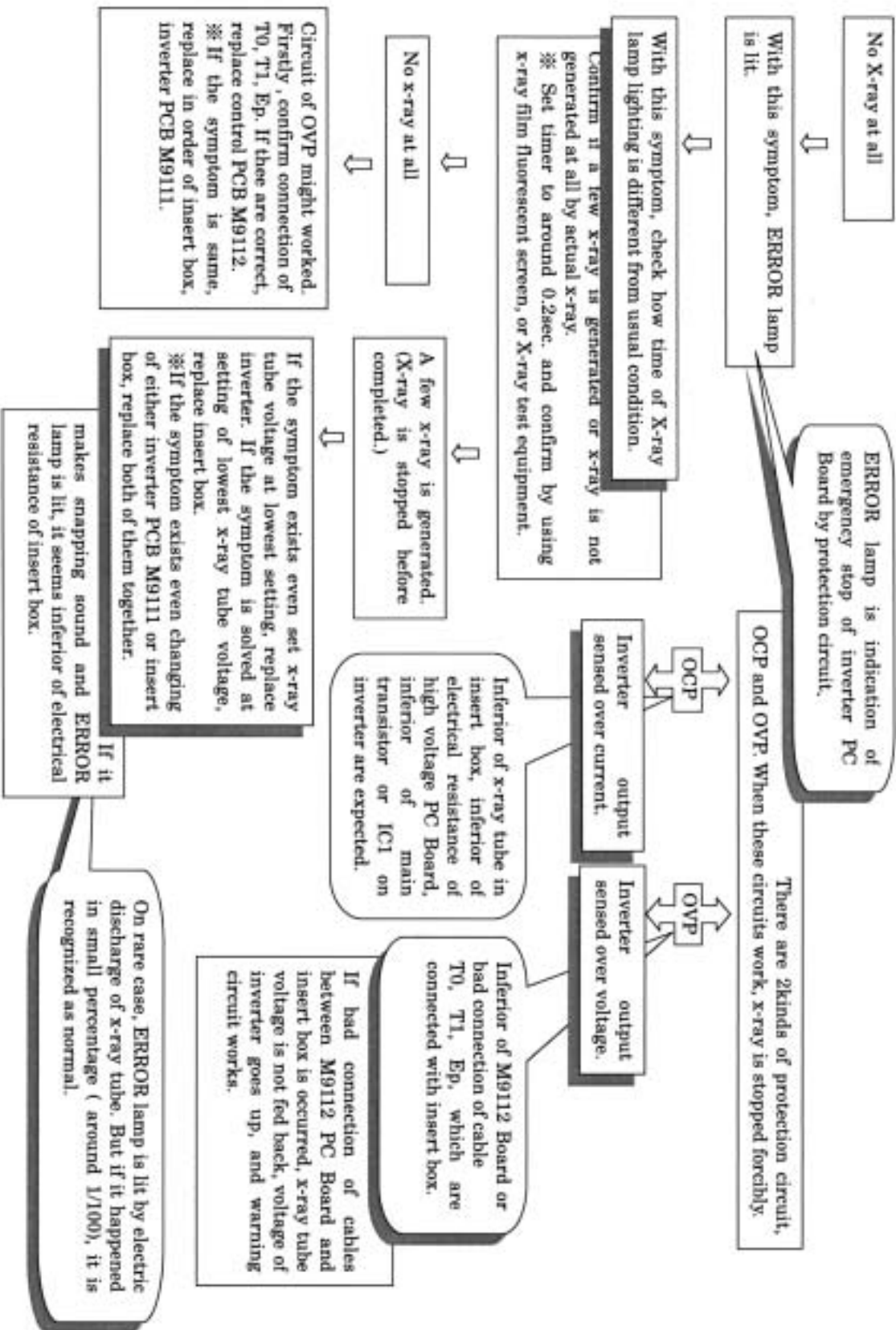
1. INDICATED LAMPS ARE NOT LIT WHEN POWER SWITCH IS AT "ON" POSITION



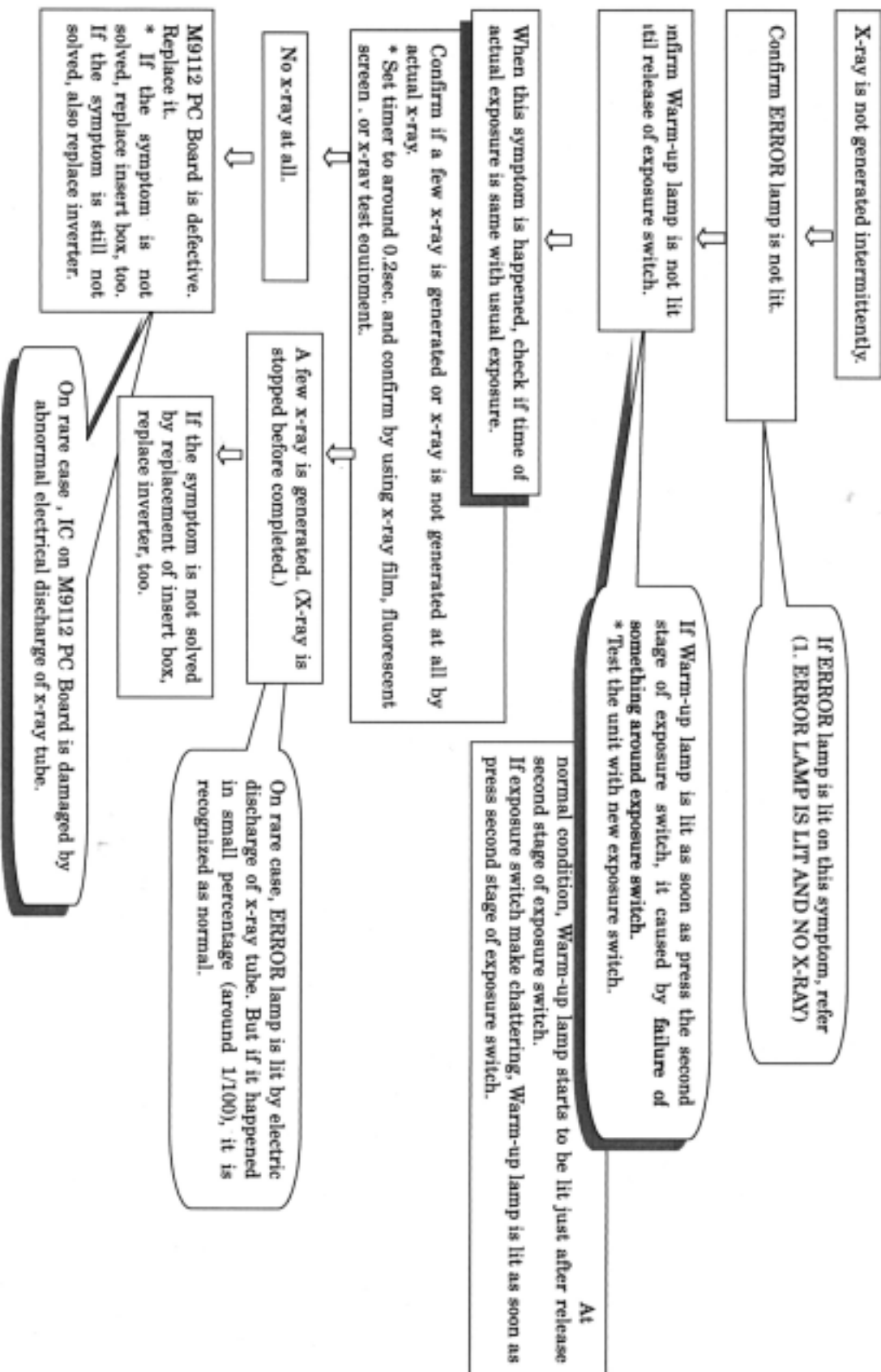
2. NO X-RAY AND ERROR LAMP IS NOT LIT



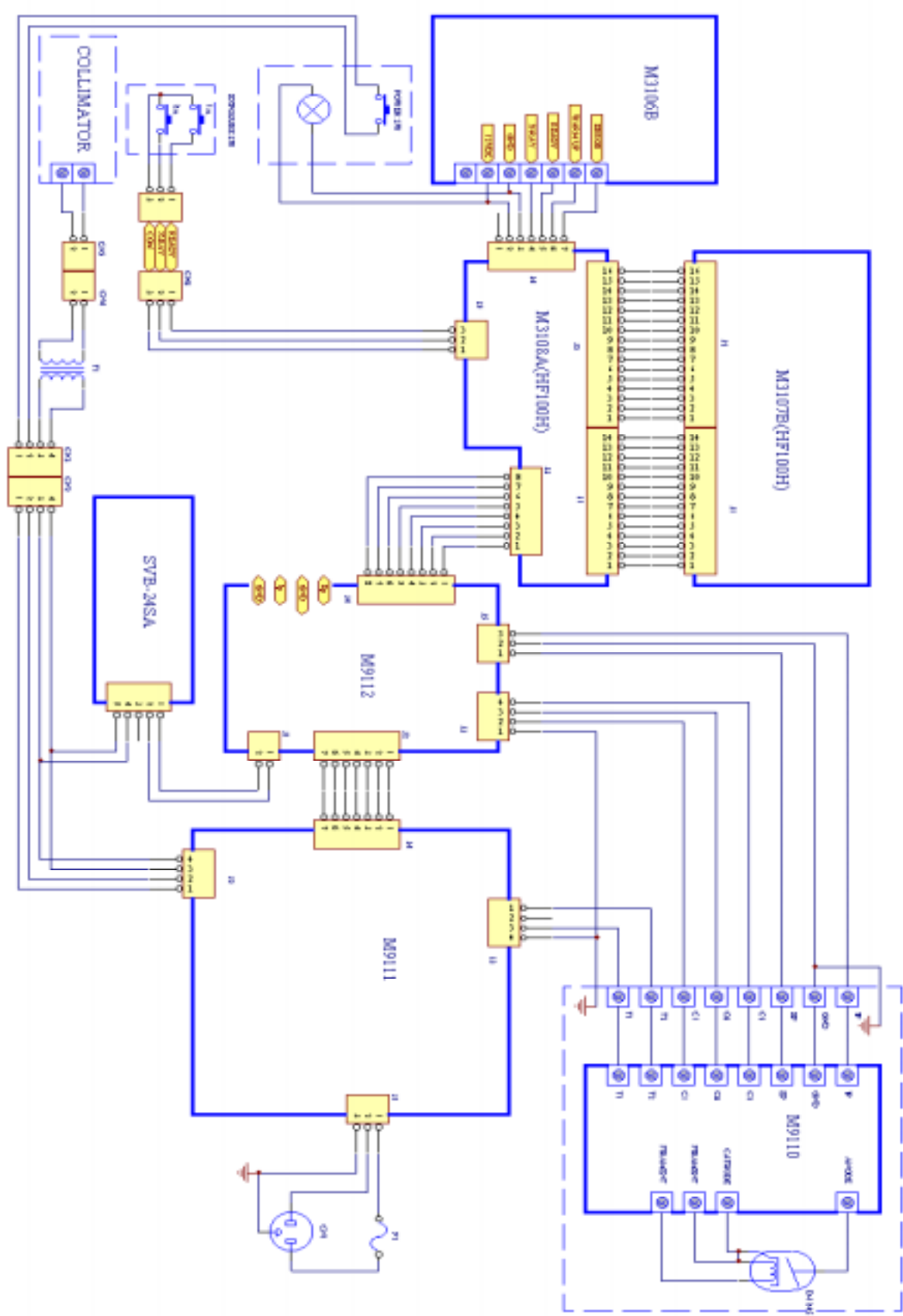
3. ERROR LAMP IS LIT AND NO X-RAY



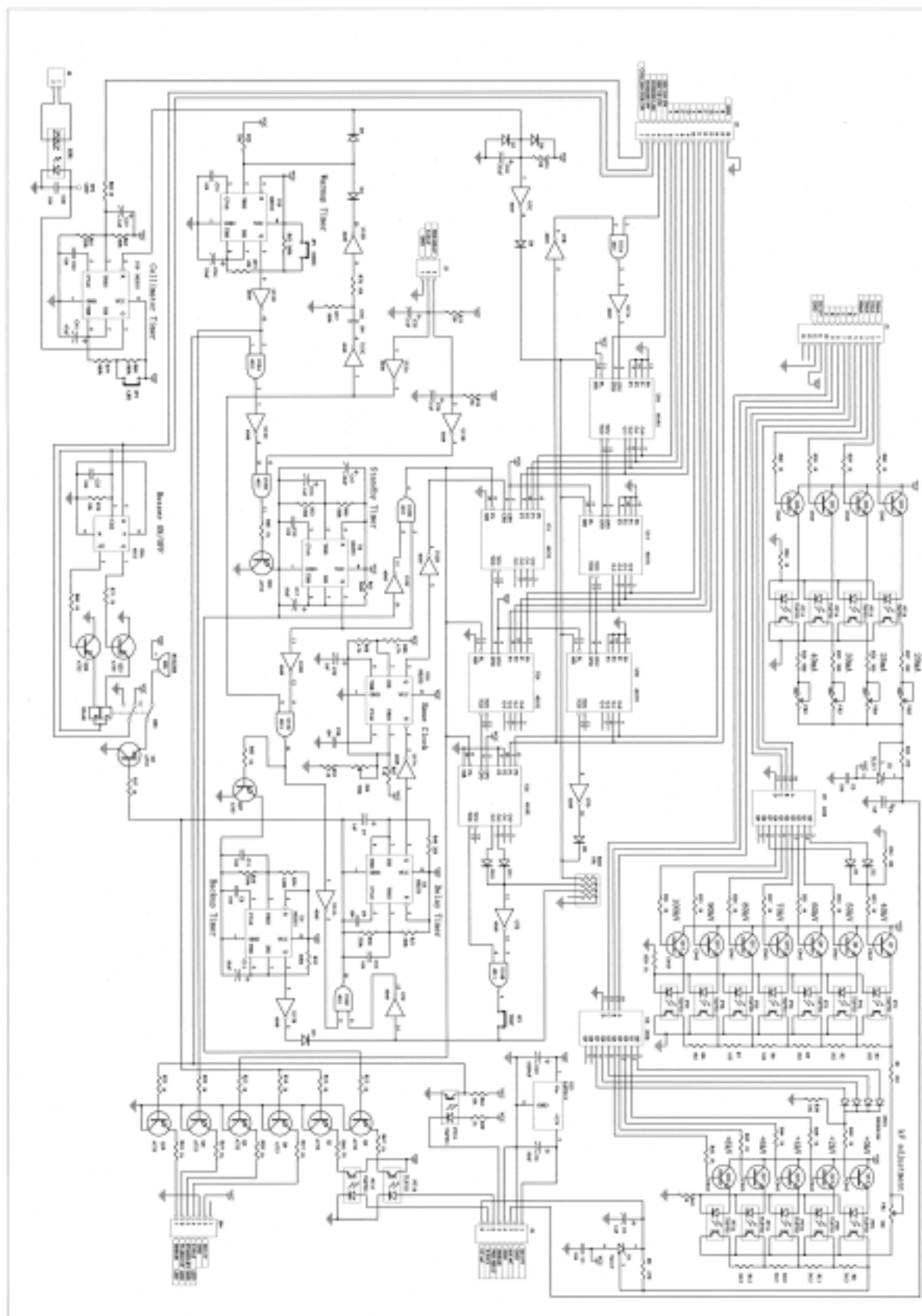
4. X-RAY IS NOT GENERATED INTERMITTENTLY



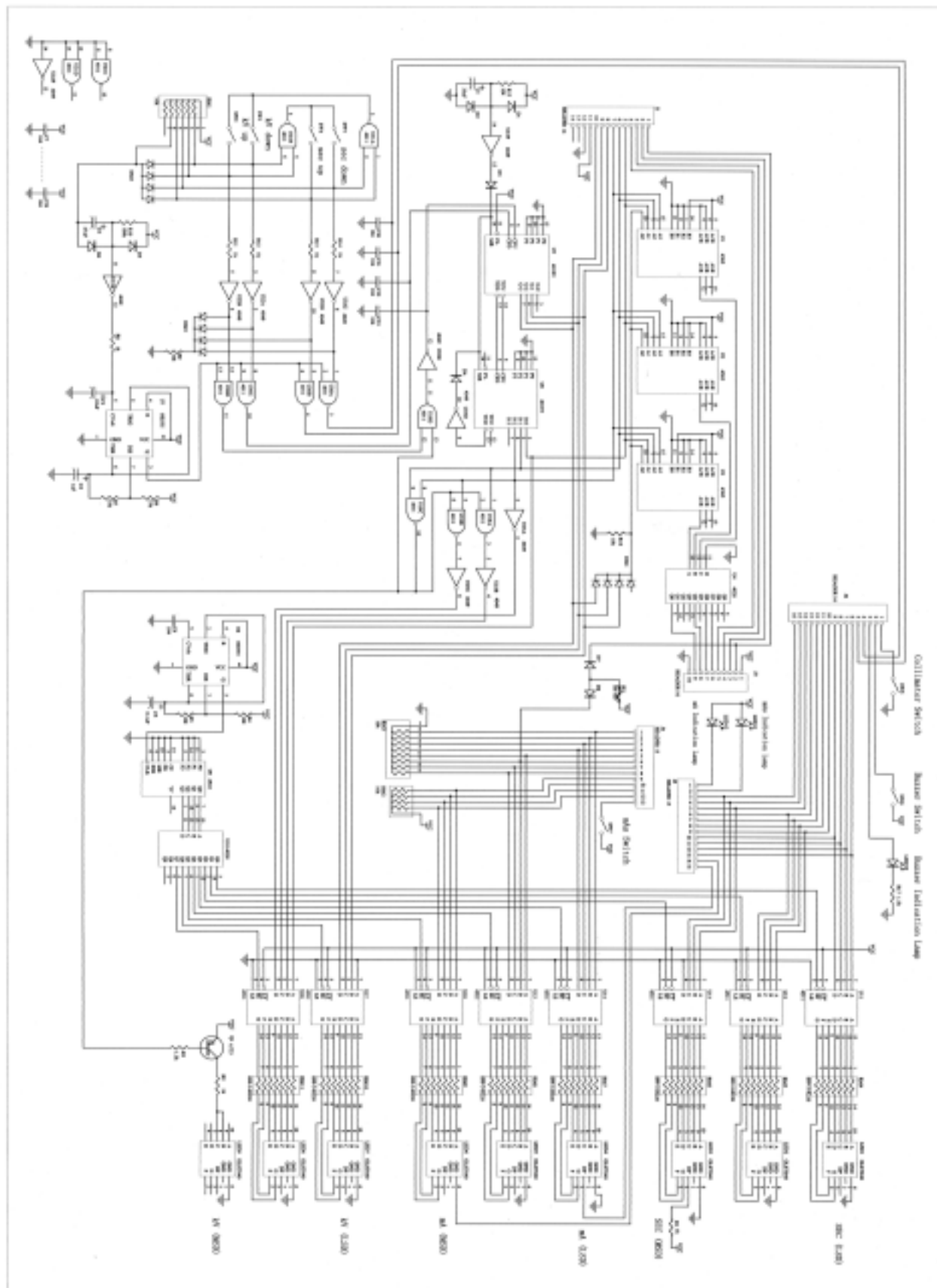
11.0 Wiring Diagram

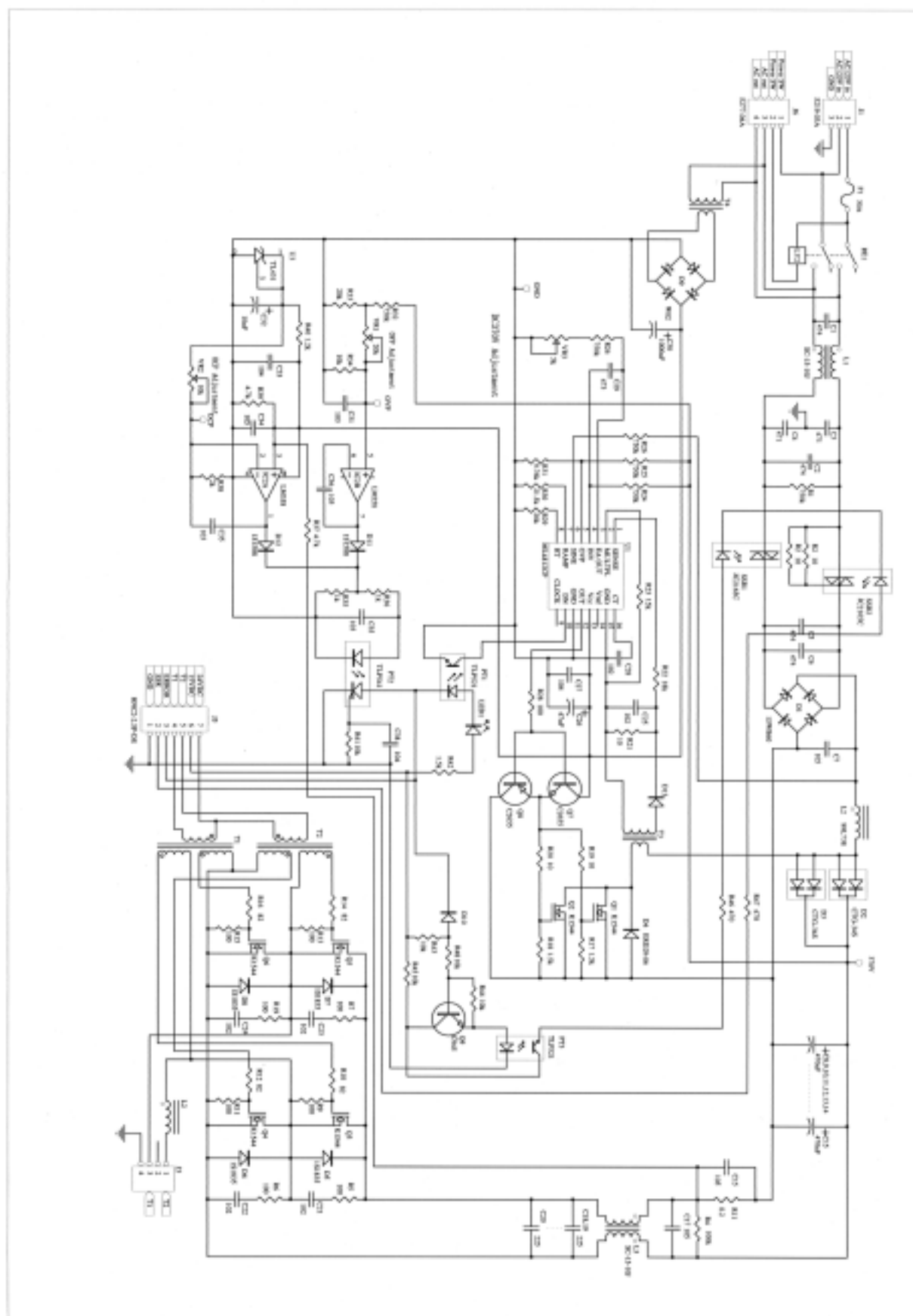


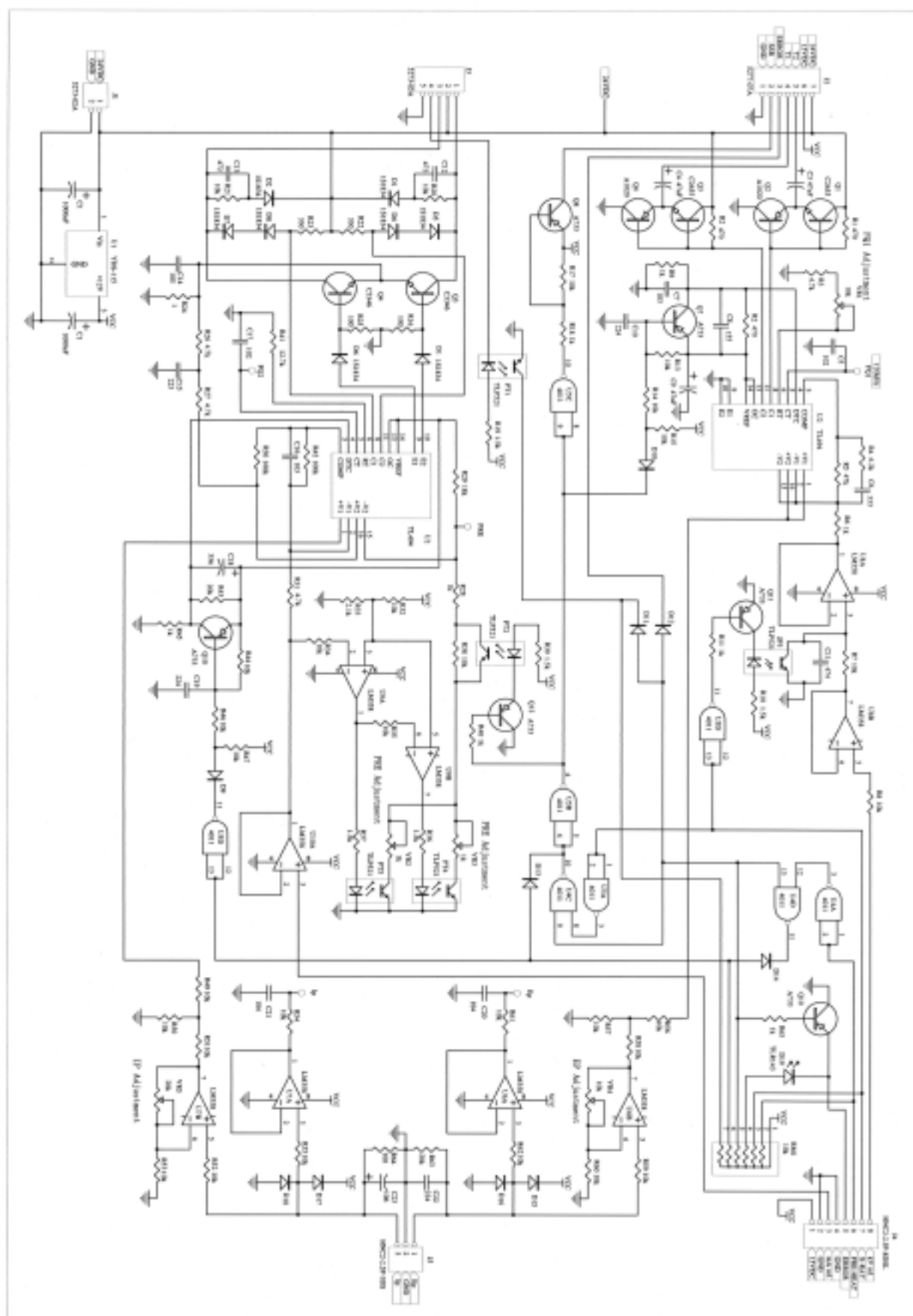
12.0-1 Schematic Diagram



12.0-2 Schematic Diagram







13.0 HF100H Parts List

Index No.	Parts No.	Designation	Qty
1	11169	COLLIMATOR (D-180HS-G)	1
2	10749	LOWER CASE (YELLOW) (HF100H)	1
3	10586	PLASTIC FOOT (TM-127 No.2)	4
4	10753	TAPE MEASRE (YELLOW)	1
5	10688	FUSE HOLDER	1
6	10742	POWER RECEPTACLE	1
7	10755	EXPOSURE SWITCH CORD RECEPTACLE(65902-004)	1
8	10690	MOUNTING PLATE (WITHOUT DEGREES)	2
9	10081	NYLON WASHER	4
10	10082	METAL SPACER	2
11	10083	SPLIT LOCK WASHER	2
12	10084	HOLDING SCREW	2
13	10584	LEAD CUP WITH 1.0mm AL FILTER	2
14	10818	HOLDING PARTS	2
15	10756	FRONT PANEL (YELLOW)	1
16	11170	MOUNTING RING FOR D-180HS-G	1
17	11171	MOUNTING PLATE	1
18	11172	FIXING PLATE	1
19	11173	SPACER	4
20	10691	PCB M9111(115V)	1
21	10692	SIDE FRAME	2
22	10694	RUBBER PLATE (BOTTOM)	6
23	11174	FIXING MATERIAL	1
24	11066	INSERT (HF100H)	1
25	11142	BRASS RING	1
26	10696	CHASSIS	1
27	10697	SPACER (M3 X 5)	4
28	10718	PCB M9112	1
29	10757	COLLIMATOR TRANSFORMER (474-1002)	1
30	10750	POWER SUPPLY (SVB-24-SA)	1
31	10752	PCB M3108A (HF100H)	1
32	10585	SPACER (M3 X 10)	2
33	10895	PCB M3107BH (HF100H)	1
34	10702	SPACER R-5(6d. X 5)	5
35	10703	PCB M3106 (WITH CORD) (7 segment)	1
36	10748	UPPER CASE COMPLETE LATELING (YELLOW)	1
37	10076	ORNAMENT WASHER FOR ORNAMENT SCREW M3	4
38	10075	ORNAMENT SEREW (EP-M3 X 8)	4
39	10714	LED INDICTING LAMP (ORANGE)	1
40	10713	LED INDICTING LAMP (GREEN)	1
41	10715	LED INDICTING LAMP (RED)	1
42	10760	SHEET KEY PLATE	1
43	10662	POWER SWITCH (MORON-FHA WITH SHIELD)	1
44	10663	POWER SWITCH SHIELD (MORON -FH)	1
45	10708	RUBBER BLOCK	4
46	10709	PLASTIC SHIELD PLATE	1
47	11162	EXPOSURE SWITCH(HS-M1)	1
48	11163	EXPOSURE SWITCH CORD (HS-M1)	1
49	11057	COLLIMATOR FUSE HOLDER & FUSE	1

OPERATOR'S AND INSTALLER'S MANUAL

FOR

"COLLIMAX" X-RAY COLLIMATOR

MODEL D-180HS-G

COLLIMAX CORPORATION

1-11, 2-Chome, Noge

Setagaya-ku, Tokyo, Japan

TABLE OF CONTENTS

*FOREWORD	Page 1
*WARNING	Page 1
SECTION I. PRODUCT DESCRIPTIONS	
** General Description	Page 1
** Features and Performances	Page 1 & 2
* Specifications	Page 2
** Compatibility	Page 2 & 3
** Name of Each Part	Page 4
SECTION II. INSTALLATION AND OPERATION	
*** Responsibility of Installer	Page 5
*** Electrical Supply Requirement	Page 5
*** Installation Method	Page 5 & 6
** Operation	Page 6
** Cares to be taken on Operation	Page 6
SECTION III. INSTRUCTIONS FOR MAIN ADJUSTMENT DEVICES	
*** Lamp Replacement and Adjustment Method of Lamp Filament Position	Page 6 & 7
*** Alignment Check and Adjustment Method	Page 8
*** Plastic Mirror Replacement Method	Page 9
SECTION IV. MAINTENANCE	
** Compliance Maintenance Schedule	Page 10
*** Circuit Diagram	Page 10*

* marked : Common to Operators and Installers.

** marked : For Operators Only.

*** marked : For Installers Only.

FOREWORD

This manual is prepared to guide the use of "Collimax" Model D-180HS-G X-Ray Collimator. This manual provides explanations of the function, operation and maintenance procedures etc.

One who installs and or uses this collimator must read this manual with care to understand this product prior to installation and operation.

WARNING

"Collimax" Model D-180HS-G X-Ray Collimator is designed and constructed within the specifications imposed by DHEW and within practical limitations to provide protection against all unwanted x-radiation emissions. One who installs and or uses this collimator must be well acquainted with instructions in this manual pertaining to the proper use.

SECTION I. PRODUCT DESCRIPTIONS

General Description

This X-Ray Collimator is designed for such applications as shown in the "Specifications" of this manual and must be used with the x-ray tube to restrict and define the area covered by the x-ray beam and also to reduce stray radiation. The beam that is collimated by the 2 control knobs should cover the smallest area of the patient necessary to produce the required radiograph. The collimator that allows a stepless adjustment of a field size utilizes a light localizer to project a visible beam with coverage equivalent to the coverage of the x-ray beam.

Features and Performances

1. Provided with a push button timer to automatically switch off the lamp of light localizer in 30 seconds.
2. Equipped with special Ring Device by which the center of collimator is adjustable by ± 2 mm to align the center of visible beam with the one of x-ray beam, and yet the collimator can be self rotated.
3. The lamp of light localizer is easily replaceable with minimized error of the same lamp position and the lamp filament position can be easily adjusted.
4. Maximum shutter opening of collimator is less than 35 cm x 35 cm at SID 65 cm.
5. Minimum x-ray field size at SID 100 cm is less than 5 cm x 5 cm.
6. The average illuminance of light field at SID 100 cm is 180 lux or more.
7. The contrast ratio on the light field edges is 3.5 : 1 or more, which allows an easy identification of light field and its size.
8. Provided with calibration scales indicating the light field sizes at each SID which accuracy variance is within 2 % of SID.
9. The leakage radiation at SID 100 cm is within 50 mR/h.
10. The insulation resistance between source circuit and a grounding metal is 2 M ohm or more.

11. The electric resistance between a grounding terminal or a grounding metal and outer case is not more than 0.1 ohm.
12. The collimator can endure, for a minimum of one minute, AC 1500V between AC line terminal and a grounding metal.

Specifications

1. Applications: For general purpose mobile x-ray units, and special purpose radiographic unit designed for use with a fixed image receptor size at a fixed SID.
2. Maximum KVP: 125kvp.
3. Outer Dimensions: 182mm × 197mm × 140mm.
4. Net Weight: (approx.) 5.9kg.
5. Shutters Drive: By 2 manual control knobs.
6. Projection Lamp: Philips Type 7158 Halogen Lamp, 24V/150W rated, or an equivalent Halogen lamp of the same rating.
7. Power Supply to Lamp: AC 19V (under load), measured at lamp socket, or more.
8. Lamp Switch: Push Button Type 30 seconds Electronic Timer.
9. Minimum Line Current: 5.8A at AC 19V under load, or more.
10. Maximum Field Size: 35cm × 35cm at SID 65cm.
11. Minimum Field Size: Less than 5cm × 5cm at SID 100cm.
12. Min. Aluminum Equivalence: 0.4mm Al at 100kvp.
13. Installation Method: By installation of adaptor flange on tube housing with 4 bolts, and diagonal length of the 4 installation bolts is 92mm. Other installation methods are optionally available.
14. Tube Focal Distance: 60mm, as the standard tube focal distance, from tube focus to the bottom surface of adaptor flange, but adjustable between 60mm - 52mm by use of spacers that are supplied with each collimator.

Compatibility

This collimator is compatible and can be adopted for use with any x-ray tube (with tube housing) that meets all of the following factors.

1. Focal Distance of X-Ray Tube:
Adjustable between 60mm (standard) - 52mm from tube focus to the bottom of adaptor flange of this collimator by use of the spacers. For 60mm tube focal distance, the spacers are not used. For tube focal distance of less than 60mm, use the spacer(s) to obtain each correct tube focal distance in view of compliance with Performance Standard (e.g., 52mm: 2pcs. × 2mm thick spacers).

2. Installation Method:

By installation of adaptor flange on tube housing with 4 bolts, and diagonal length of the 4 installation bolts is 92 mm.

Other installation methods are optionally available but they must be consulted in advance with the manufacturer of this collimator.

3. Leakage Radiation:

Maximum leakage radiation from tube housing assembly must be within 50 mR/h at SID 100 cm.

4. Inherent Filtration:

Inherent Filtration of this collimator is 0.4 mm Al at 100 kVp.

5. Half-Value Layer:

Half-value layer of useful beam at a x-ray tube voltage must not be less than the values shown in Table 1 of (m) Beam Quality of Section 1020.30 under Performance Standard.

6. Applications:

For general purpose mobile x-ray systems, and special purpose radiographic systems designed for use with a fixed image receptor size at a fixed SID. Maximum tube voltage of those x-ray systems must be 125 kVp or less, in the output.

7. Power Supply to Collimator Lamp:

Loading voltage and maximum line current to collimator lamp must be AC 19 V or more and 5.8 A or more respectively, being measured at the lamp socket under load.

Note: Collimator lamp to be used must be Philips Type 7158 Halogen Lamp, rated 24 V/150 W or an equivalent Halogen Lamp of the same rating that meets the international standard (of same filament size and shape).

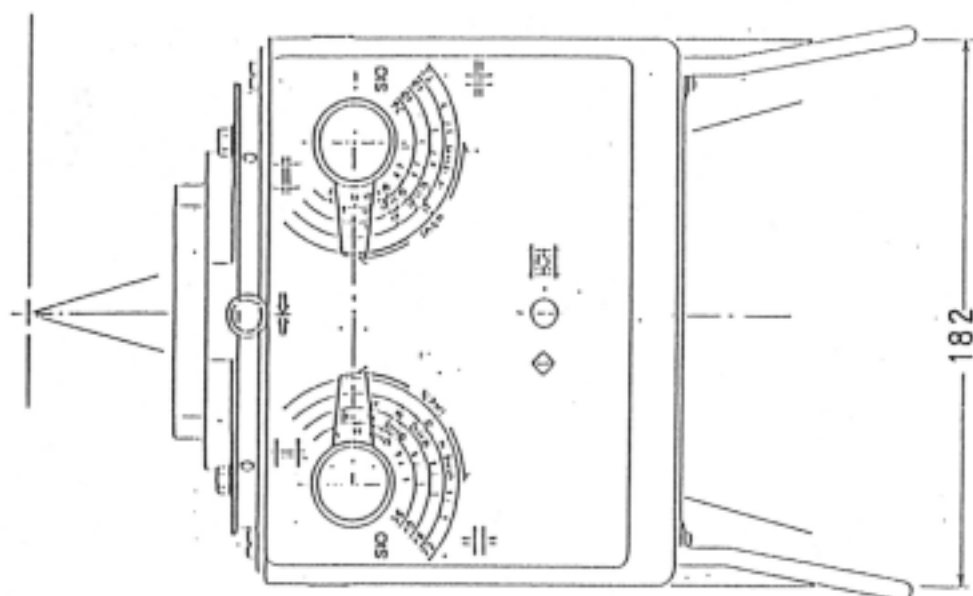
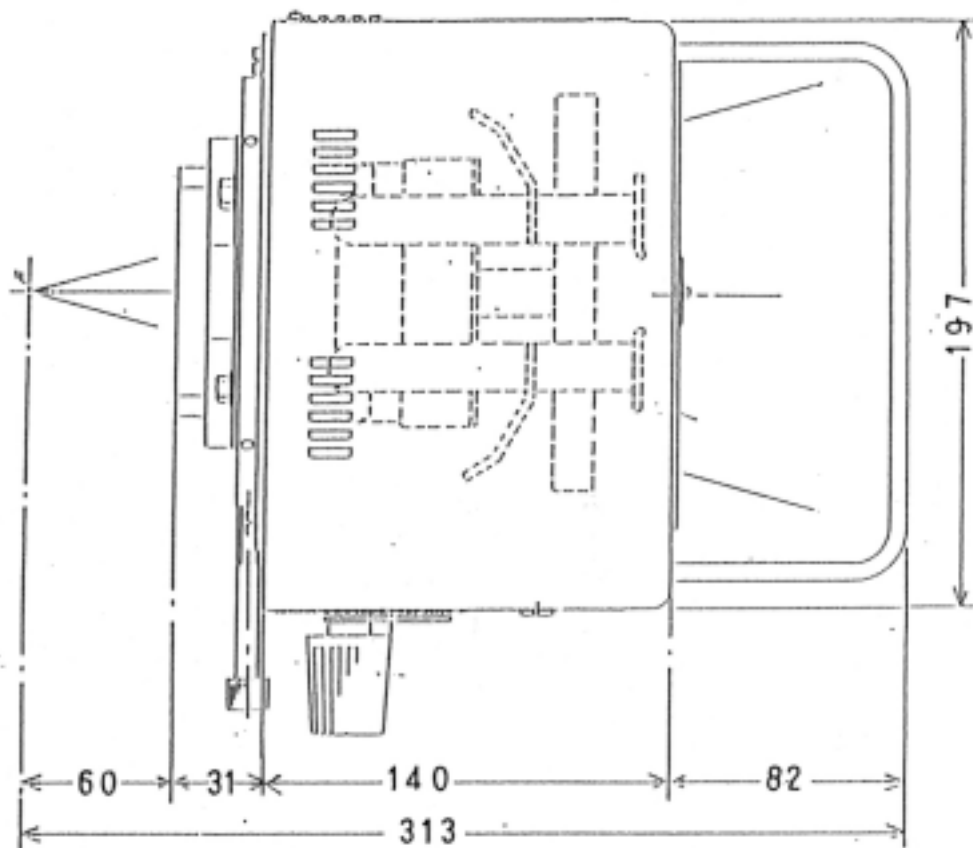
8. Others:

When collimator was combined with x-ray tube, D.S.A. (Diagnostic Source Assembly) must have illuminance of 180 lux or more at SID 100 cm, Contrast Ratio of 3.5:1 or more at SID 100 cm, and Misalignment (of light field with x-ray field) of not more than 2 % of SID.

Name of Each Part

See the drawing of next page.

Outer Appearance and Dimensions and Name of Each Part



SECTION II. INSTALLATION AND OPERATION

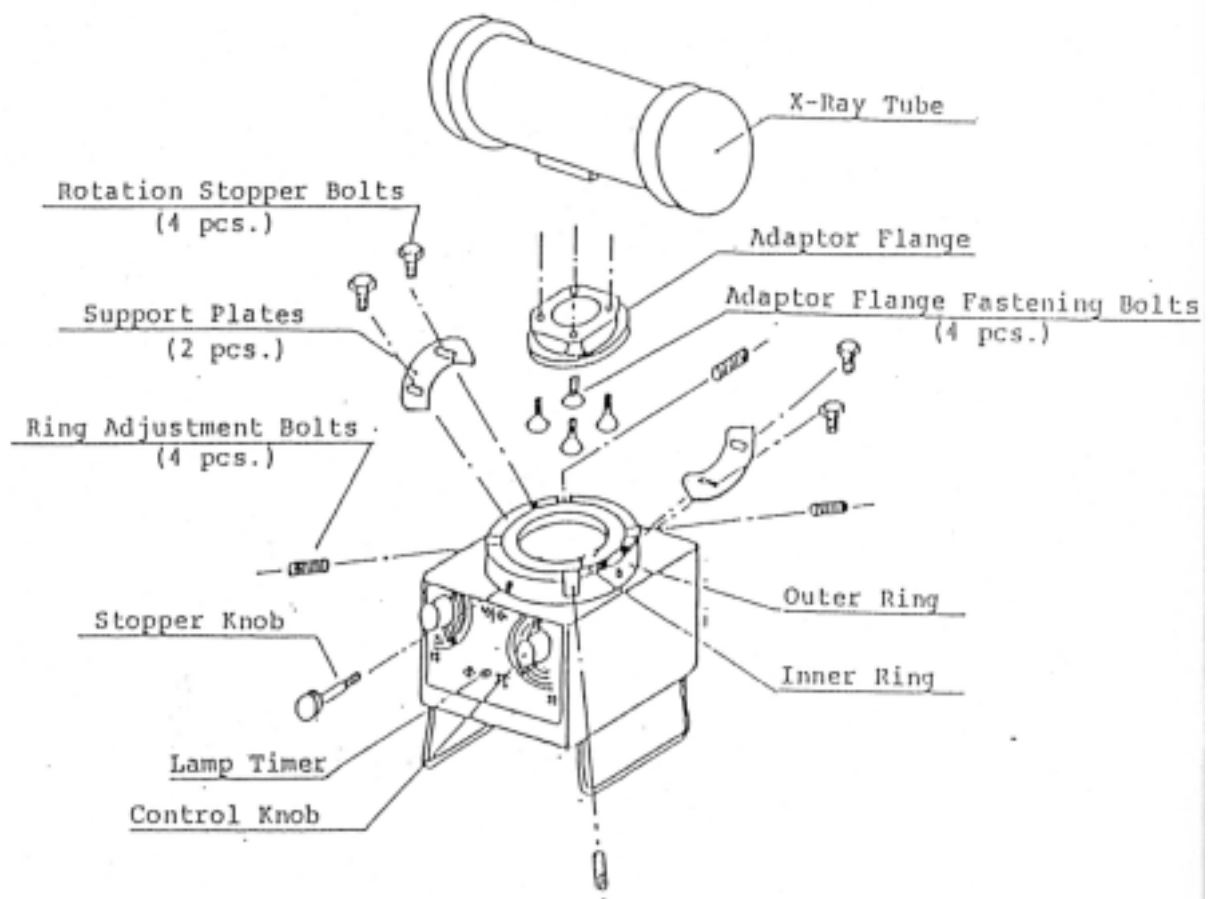
Responsibility of Installer

It is the responsibility of the installer to correctly install this collimator as instructed in this manual. The installer must certify that the x-ray equipment on which tube housing assembly the collimator was installed is in compliance with DHEW Regulations.

Electrical Supply Requirement

It is imperative that a sufficient power is supplied to the collimator lamp to obtain the specified voltage under on-load condition being measured at the lamp socket, to keep this collimator in compliance with DHEW Regulations.

Installation Method (see drawing as shown below)



1. Install the adaptor flange on tube housing assembly with 4 installation bolts.
2. Hold the collimator and place its Inner Ring over the adaptor flange, then fix the 2 Support Plates, temporarily, with the 4 Rotation Stopper Bolts.
3. Fasten Stopper Knob not to allow collimator to rotate.

4. Connect the power supply cord of lamp and push Lamp Timer to confirm that the lamp is illuminated.
5. Adjust collimator position with 4 Ring Adjustment Bolts so that the center of adaptor flange will be aligned with the center of the inner ring, then fasten firm the 4 Rotation Stopper Bolts.
6. Push Lamp Timer and make sure that light field can be collimated to a required size by operation of 2 manual control knobs.

Operation

1. Push Lamp Timer and confirm that light field is illuminated.
2. Adjust collimator position so that the centering cross mark of collimator is aligned with the center of an image receptor.
3. Collimate light field to the image receptor size operating the 2 manual control knobs.

Cares to be Taken on Operation

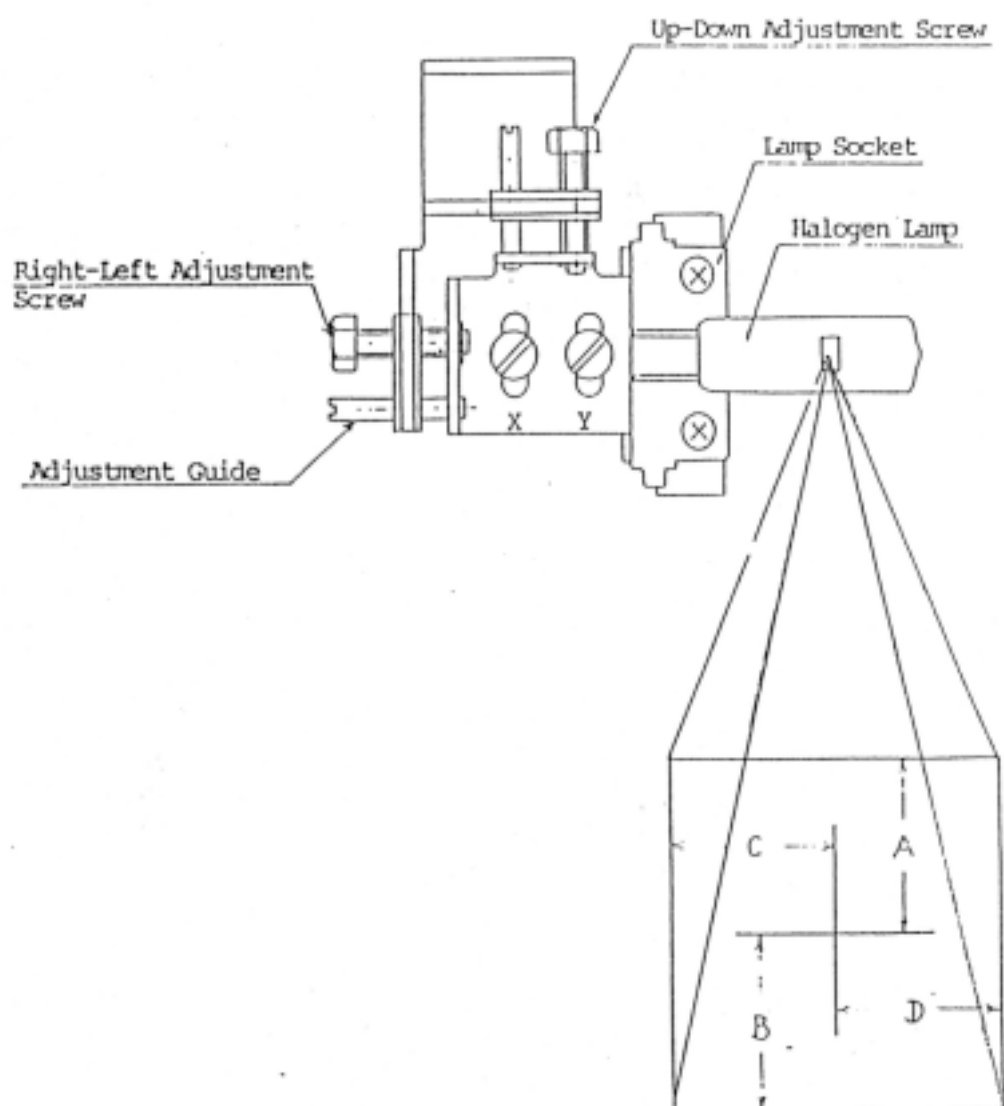
1. Do not fail to use within the specified maximum tube voltage.
2. Do not use installing on those x-ray tubes which focal distances are different from the ones specified.
3. If lamp replacement became neccessary, do after the inside temperature decreased sufficiently.
4. Never fail to use the same type of lamp as specified.
5. Do not touch on the projection lamp, plastic mirror and front acrylic plate except when it became neccessary to do so.
6. In case lamp was illuminated successively 5 times or so, keep it off for about 2 minutes till next operation for cooling purpose.

SECTION III. INSTRUCTIONS FOR MAIN ADJUSTMENT DEVICES

Lamp Replacement and Adjustment Method of Lamp Filament Position

1. For replacement of lamp, first remove the lamp cover, then remove the screen plate of lamp house, but never move the front acrylic plate.
2. Make sure first that the lamp surface temperature sufficiently decreased, and pull lamp out of the socket.
3. Wrap over the replacement lamp surface with a soft cloth or the like so as not to allow a finger to touch on the surface, and insert the lamp into the lamp socket so that the lamp pins will reach to the utmost depth of the lamp socket, then install the screen plate of lamp house.
4. After the replacement work, illuminate the lamp by pushing lamp timer, and measure if the centering cross mark is in the center of light field.
5. If the centering cross mark should be drifted from the center, adjust the lamp filament position as follows (see the drawing of next page).

- 1) Measure A size and B size:
In case A size was larger, loosen the Locking Screws(X & Y) and turn the Up-Down Adjustment Screw to left. In case B size was larger, turn the Adjustment Screw to right.
- 2) Measure C size and D size:
In case C size was larger, turn Right-Left Adjustment Screw to left. In case D size was larger, turn this Adjustment Screw to right.
- 3) At the position where A & B and C & D of light field became equal to each other lock lamp position by fastening firm the Locking Screws (X & Y).

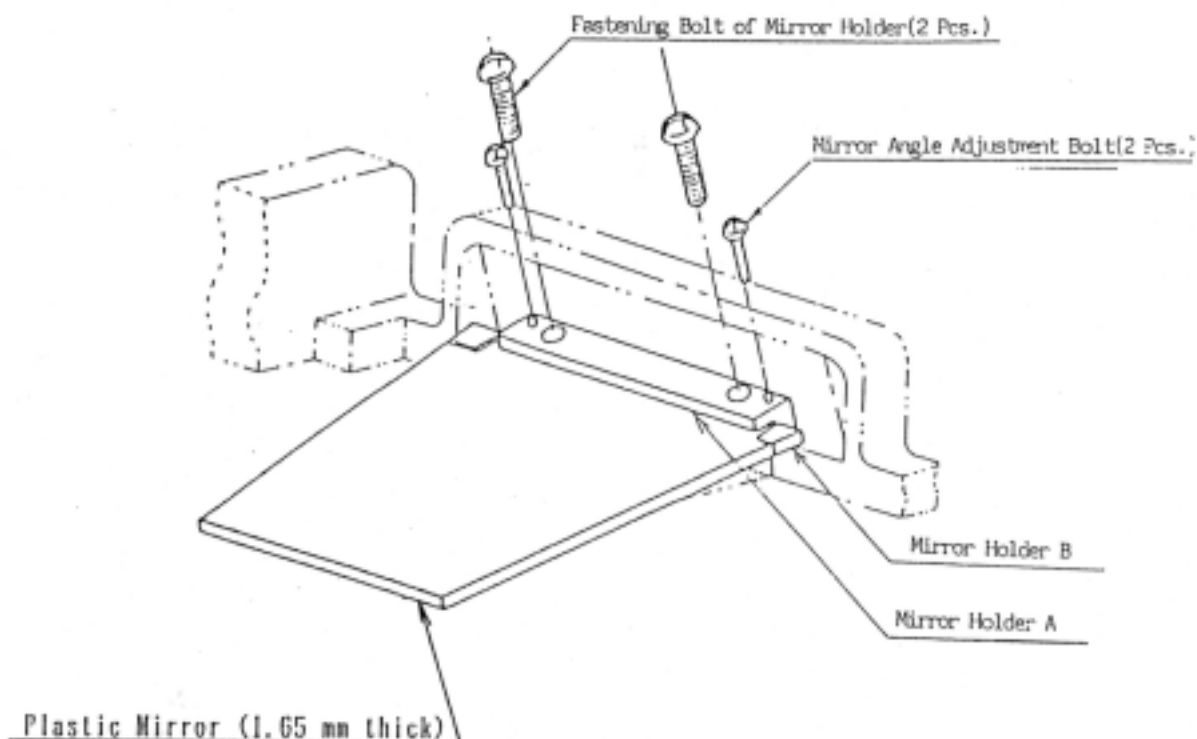


Alignment Check and Adjustment Method

1. This collimator is designed and factory adjusted to comply with Performance Requirement when it was correctly installed as specified in this manual, so far as the x-ray tube focus (target) position is correctly aligned with the center of the x-ray tube window.
However, the misalignment of light field with x-ray field can be checked and adjusted, as follows, if there might be a possibility that the misalignment might exceed 2 % of SID due to the Off-Center of tube focus position and or if check of misalignment was required.
2. Prepare a fluorescent paper on which the center and a field size are marked (e.g., a center cross mark and 125 mm x 125 mm, or 250 mm x 250 mm, or 350 mm x 350 mm).
3. Place the fluorescent paper on a flat surface so that it becomes perpendicular to the center line of light beam. Illuminate collimator lamp and align the center of fluorescent paper with the center cross mark of light field, at SID 100 cm, then collimate to the size marked on the fluorescent paper.
4. Make a longest possible x-ray exposure (if fluoroscopic condition is not available) and observe if the x-ray field is aligned with light field. If there'd be a noticeable misalignment (entire field is usually drifted to one direction due to the off-center of tube focus position), adjust the entire collimator position as below.
 - 1) Keep collimator mounted on x-ray tube, and a little loosen 4 pcs. of Rotation Stopper Bolts (see drawing in "Installation Method"), then loosen 4 pcs. of Ring Adjustment Bolts.
 - 2) Make x-ray exposure again and confirm that x-ray field is aligned with the field size marked on the fluorescent paper (if necessary, collimate x-ray field to the marked field size).
Illuminate collimator lamp and align the light field size to the x-ray field size by adjusting the collimator position.
At the position where it was aligned, fasten the Ring Adjustment Bolts and also fix the Rotation Stopper Bolts.
 - 3) If there'd be still a noticeable misalignment after above work and if there'd be a need to further adjust, the alignment can be adjusted by moving the lamp position as described in "Lamp Replacement and Adjustment Method of Lamp Filament Position".
 - 4) In case of alignment check with a radiographed film, prepare a film cassette a little larger than the field size, illuminate lamp timer, measure the light field edges and mark them on the film cassette with a fuse wire or the like, then make a radiography and measure the misalignment on the developed film.
The said mark with a fuse wire etc. will be placed so that it appears on the developed film even when x-ray field was smaller than light field.
The radiography will be made under minimum required condition.
If the misalignment measured on the radiographed film should exceed 2 % of SID as required by Performance Standard, further adjustment of alignment can be made in the same manner as above described.

Plastic Mirror Replacement Method

1. For replacement of plastic mirror, first remove the front acrylic plate, and open collimator shutters to the maximum positions in both of longitude and latitude.
2. Remove the installation screws of mirror holder (2 pcs.) and mirror holder A. Then, remove the plastic mirror with mirror holder B that is binded to the mirror.
3. Install the replacement plastic mirror fastened with mirror holder A, then temporarily fix the front acrylic plate.
4. Place a thin paper in front of the acrylic plate, then illuminate the lamp and gradually collimate the light field in both of longitude and latitude. At the position where the centering cross mark was aligned with the center of light field, lock the front acrylic plate with its 2 fastening screws.



SECTION IV. MAINTENANCE

1. Make a cleaning, every 3 months, of the front acrylic plate, collimator case and lamp surface. If a finger touched on the lamp surface, wipe out the finger print.
2. The plastic mirror will be replaced at any time if it was broken.
3. Make sure, before every use, that the lamp is illuminated when pushed the lamp timer.
4. Periodically check and make certain that warning label has not been defaced or worn so as to be illegible.

Compliance Maintenance Schedule

1. Conduct Illuminance Test, once a year and whenever lamp was replaced, to make certain that the average illuminance of light field at SID 100 cm is 180 lux or more.

If the measured illuminance was less than 180 lux, check the loading voltage and line current to the lamp, and when necessary, replace the lamp to a new one, then again make sure that the illuminance is not less than 180 lux.

Note: The replacement lamp must be Philips Type 7158 Halogen Lamp, rated 24 V/150 W or an equivalent Halogen Lamp of the same rating that meets the international standard (of same filament size and shape).

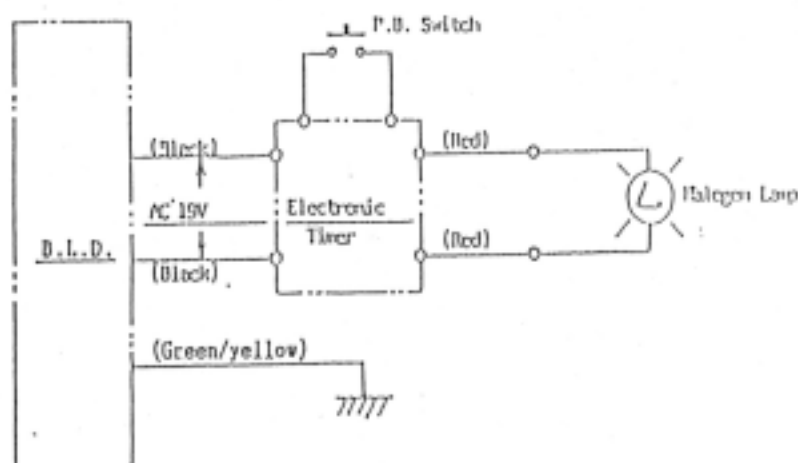
2. Make sure, whenever lamp was replaced, that the centering cross mark of collimator complies with the center of light field. If it is drifted from the center of light field, adjust the lamp filament position till both the center comply with each other.

For adjustment method, see "Lamp Replacement and Adjustment Method of Lamp Filament Position" in Section III of this manual.

3. Check once a year and whenever lamp was replaced, and make certain that the contrast ratio of light field is 3.5:1 or more at SID 100 cm.

4. Check once a year and whenever lamp was replaced, and make certain the misalignment of light field with x-ray field is within 2 % of SID. If the misalignment should be more than 2 % of SID, adjust it to within 2 % of SID. For the adjustment method, see "Alignment Check and Adjustment Method" in this manual.

CIRCUIT DIAGRAM



15.0-1 Pre-adjustment with HF Tester

The HF tester is a tool to inspect and adjust a control panel.

The upper control panel is removed from the body after four screws on the side of the body are removed.

The control panel is connected with the body with three cables of the power supply cable, interface cable, earth wire, and remove these three cables.

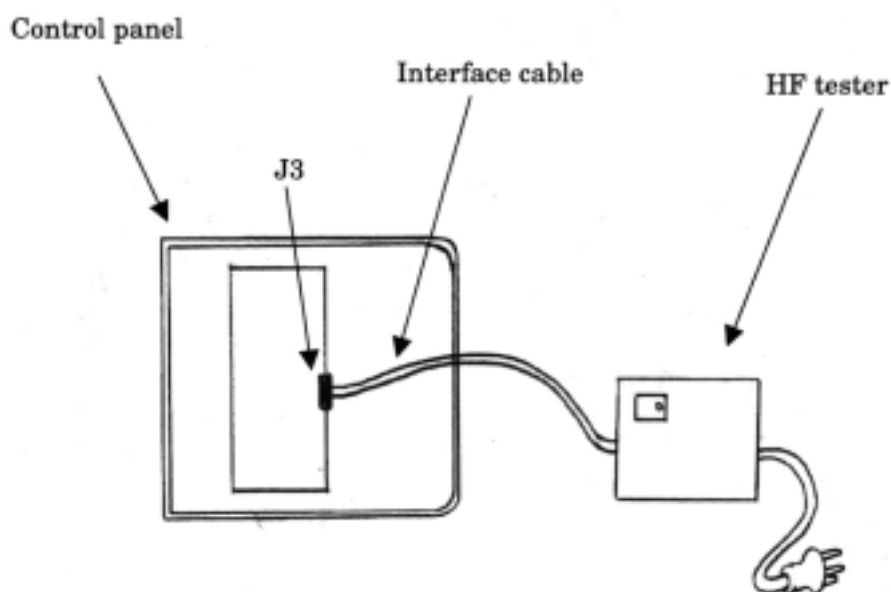
Connect the interface cable of the HF tester to J3 of the M3108 circuit board of the control panel.

Connect a HF tester with the power supply, and turn on a power switch.

kV can be measured with kV+ and the GND terminal.

mA can be measured with mA+ and the GND terminal.

Exposure time can be measured with TIM+ and the GND terminal.



15.0-2 Pre-adjustment without HF Tester

※ Each PC Board delivered from the factory has already been adjusted.

1. M3108A adjustment (Refer to page 8)

kV adjustment : **kV is decreased by turning VR1 clockwise.**

1. Set the kV selector to 100kV.
2. Check the DC voltage between the connector J3-8pin (+) and J3-2pin (-) on the M3108A PC board. (Do not remove any cable.)
3. Adjust the DC voltage to be 5V by turning VR1.

mA adjustment : **mA is decreased by turning VR5 clockwise.**

1. Confirm the mA indicator to be 20mA.
2. Check the DC voltage between the connector J3-3pin (+) and J3-2pin (-) on the M3108A PC board. (Do not remove any cable.)
3. Adjust the DC voltage to be 2V by turning VR5.